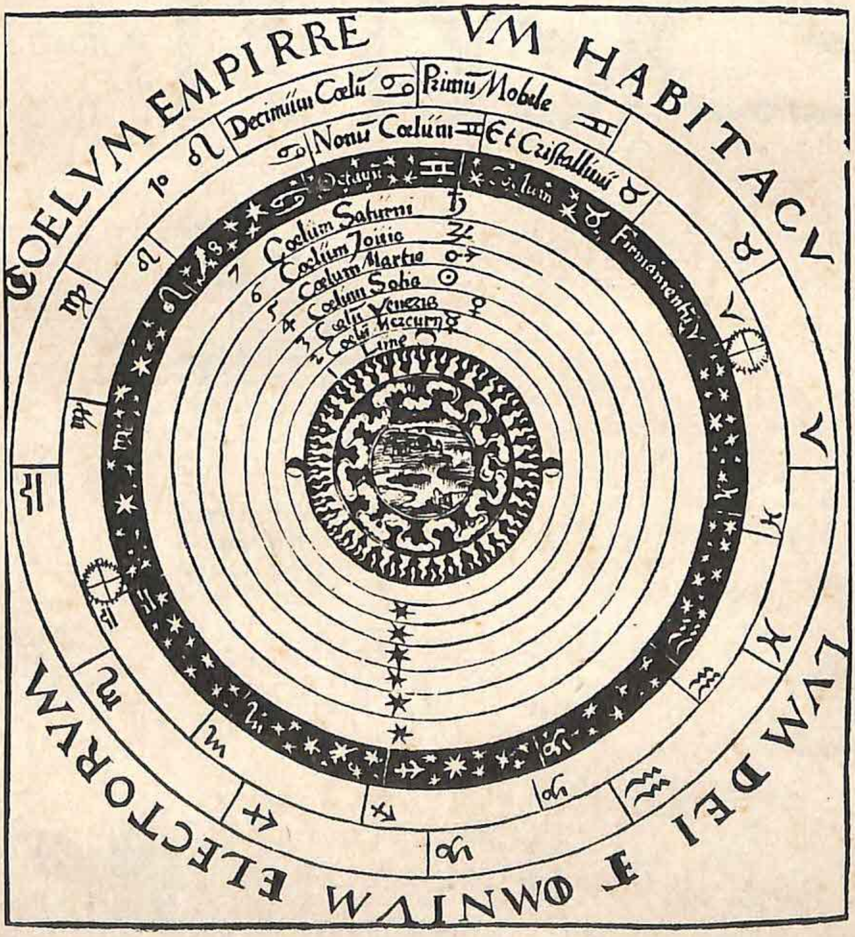
ANSWERS TO EVEN-NUMBERED PROBLEMS

to accompany

UNIVERSITY PHYSICS

SIXTH EDITION

Sears • Zemansky • Young



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ANSWERS TO EVEN-NUMBERED PROBLEMS

Chapter 1

1-2	10^3 kg·m^{-3}
1-4	77.1 kg
1-6	a) 0.040% b) 0.0000085%
1-8	a) 0.1% b) 0.1% c) 0.05%
1-10	122 in^3
1-12	0.9954 to 0.9969; yes
1-16	3.12 mi, 2.20° W of N
1-18	70.0 m, 26.3° E of N
1-20	15.0 N, 53.3° above $+x$-axis; 25.9 N, 27.7° below $-x$-axis
1-22	a) 2 in., $+x$-direction b) 3.46 in., $+y$-direction, $-y$-direction
1-24	a) 6 cm, 1 cm b) 6.08 cm, 9.5° above $+x$-axis c) -2 cm, 5 cm d) 5.38 cm, 111.8° from x-axis
1-26	2.83 km, 3.4° E of N
1-28	5.66 units, 32.0° from direction of A
1-30	a) $\sqrt{13}$, $\sqrt{5}$ b) $3i + j$ c) $\sqrt{10}$, 18.4° above $+x$-axis d) $i + 5j$ e) $\sqrt{26}$, 78.7° above $+x$-axis
1-32	$i \cdot i = 1$ $i \cdot j = 0$ $i \cdot k = 0$ $j \cdot i = 0$ $j \cdot j = 1$ $j \cdot k = 0$ $k \cdot i = 0$ $k \cdot j = 0$ $k \cdot k = 1$
1-34	54.7°; no
1-36	$17i - 2j - 7k$; $\sqrt{342}$
1-38	90°

Chapter 2

2-2	34.6 N horizontal, 20.0 N vertical
2-4	a) 173 N, 100 N; -212 N, 212 N; -93.3 N, -124 N b) 230 N, 54.9° above $-x$-axis c) 230 N, 54.9° below x-axis
2-6	381 N, west; 960 N, north
2-8	14.1 N, 135° from F_1
2-10	464 N, 17.8°
2-12	a) Gravity b) Gravitation force of earth
2-14	400 N, 400 N, 200 N

2-16 60°
2-18 a) 1545 N b) 1.15°
2-20 a) 146 N, 179 N, 200 N b) 200 N, 283 N, 200 N c) 546 N, 669 N, 200 N
d) 166 N, 57.4 N, 125 N
2-22 a) 5.77 N, 11.5 N b) 11.1 N, 11.0 N
2-24 a) 2.24 m b) 0.528 m
2-26 a) 19.5° b) 10.0 N c) 28.3 N
2-28 a) Zero b) 5 N c) 8 N d) 4 N e) 4 N
2-30 Down 53.1°, up 36.9°
2-32 $\mu w(\cos\phi + \mu \sin\phi)$
2-34 3.92 N, 0.399
2-36 b) 0.251

Chapter 3

3-2 5 cm·s^{-1}, −4 cm·s^{-1}
3-4 a) 0, 1, 1.5, 2.5, 2.5, 2.5, 1, 0 m·s^{-2}. Constant between $t = 6$ s and $t = 12$ s.
b) 2 m, 23 m, 2.5 m·s^{-2}, 1.3 m·s^{-2}, 0
3-8 a) +1.5 m·s^{-2}, right b) −1.5 m·s^{-2}, left c) −1.5 m·s^{-2}, left
d) +1.5 m·s^{-2}, right d) −4 m·s^{-2}, left f) +4 m·s^{-2}, right g) a, c; b, d
3-10 33.3 m·s^{-1}
3-12 a) 1.67 m·s^{-2} b) 5 m·s^{-1}
3-14 a) 33.0 m b) 111 m
3-16 a) Yes b) 400 m past point where brakes are applied.
3-18 750 m
3-20 a) 2 m·s^{-2}, south b) 5 s c) 100 m
3-22 a) 19.8 m·s^{-1} b) 4.04 s
3-24 a) 20.9, 21.3, 20.1, 10.4 m; 2.55, 0.10, −4.80, −14.6 m·s^{-1} b) 2.59 s
c) −20.4 m·s^{-1}
3-26 5.92 m
3-28 a) 7.67 m·s^{-1} b) 0.782 s c) 0.391 s d) 2.25 m
3-30 a) 92.4 m·s^{-1} b) 122.5 m
3-32 a) 3.06 s b) 45.9 m c) 2.04 s d) 4.08 s e) 0, 6.12 s f) 1.53, 4.59 s
g) 0.897, 5.23 s h) 9.8 m·s^{-2}, down i) 9.8 m·s^{-2}, down
j) 9.8 m·s^{-2}, down
3-34 a) 815 ft·s^{-2} b) 25.4 c) 1320 ft
d) Only if a varies; average acceleration is 20.6g.
3-36 a) 10 m b) 300 m c) 20 m d) 6 m·s^{-1} e) 6 s
3-38 a) 6 m, −16 m·s^{-1}, −40 m·s^{-2} b) $t = 0$ to $t = 1.41$ s c) $t = 0$ to $t = 2.27$ s
d) 4.35 m·s^{-1}
3-40 a) 8 m·s^{-1} b) 12.3 m
3-42 $v^2 = v_0^2 + K(y_0^2 - y^2)$
3-44 d) 1/90 m^{-1} e) 0.400 m·s^{-2}
3-46 40 min, 30 min
3-48 a) car A b) 0, −1.686, 1.186 s c) −1, 2/3 s d) −1, 2/3 s

Chapter 4

4-2 a) 1.99×10^7 m b) 1.99×10^8 m
4-4 a) 10 kg b) Yes c) Yes, if w and g are measured at the same location.
4-6 a) 5.56×10^{-4} s b) 1166 N, 262 lb
4-8 a) 0.025 m, 0.01 m·s^{-1} b) 0.2 m, 0.02 m·s^{-1}
4-10 0.128

4-12 3.40×10^{-5} N, $3.47 \times 10^{-6}\ w$
4-14 2.58×10^{8} m
4-16 $5.12 \times 10^{-8}\ \text{m}\cdot\text{s}^{-2}$, along vertical line
4-18 2.4
4-20 $5.20\ \text{m}\cdot\text{s}^{-2}$
4-22 $16\ \text{ft}\cdot\text{s}^{-2}$
4-24 a) $4.9\ \text{m}\cdot\text{s}^{-2}$ down b) No acceleration
c) $4.9\ \text{m}\cdot\text{s}^{-2}$ up (No conclusion about velocity is possible.)
4-26 a) 320 m b) 5000 N
4-28 a) 80 N forward b) 78.4 N backward
4-30 a) $4.9\ \text{m}\cdot\text{s}^{-2}$ b) $3.20\ \text{m}\cdot\text{s}^{-2}$
4-32 a) $8\ \text{ft}\cdot\text{s}^{-2}$ up b) $8\ \text{ft}\cdot\text{s}^{-2}$ down c) Yes; elevator is in free fall!
4-34 a) $2.2\ \text{m}\cdot\text{s}^{-2}$ b) $10.3\ \text{m}\cdot\text{s}^{-2}$
4-36 a) 10.0 lb b) 11.4 lb
4-38 a) 5.09 N b) 2.96 s c) 32.5 m d) 5.26 s e) $12.4\ \text{m}\cdot\text{s}^{-1}$
f) Only part (a).
4-40 a) $mg - F\sin\theta$ b) $\mu_k(mg - F\sin\theta)$ c) $(F/m)(\cos\theta + \mu_k \sin\theta) - \mu_k g$
d) $\mu_k mg/(\cos\theta + \mu_k \sin\theta)$
4-42 a) $F\sin\theta + mg\cos\theta$ b) $\mu_k(F\sin\theta + mg\cos\theta)$
c) $(F/m)(\cos\theta - \mu_k \sin\theta) - g(\sin\theta + \mu_k \cos\theta)$
d) $mg(\sin\theta + \mu_k\cos\theta)/(\cos\theta - \mu_k\sin\theta)$ e) $\arctan(1/\mu_k)$
4-44 a) 0.824 s b) 59.0 N
4-46 a) 10.7 kg b) 23.6 N, 83.2 N
4-48 a) 3.92 m b) 2.35 N, 1.96 N c) 4.70 N
4-50 a) 0, 0 b) 0, 0 c) 0.05, $9.9\ \text{m}\cdot\text{s}^{-2}$ d) 9.9, $29.6\ \text{m}\cdot\text{s}^{-2}$
4-52 a) $1.36\ \text{m}\cdot\text{s}^{-2}$ b) 5.66 N
4-54 648 N
4-56 a) Left b) Right c) Right d) Left e) Down slope
f) Perpendicular to plane
4-58 a) $4.0\ \text{m}\cdot\text{s}^{-2}$ b) $1.0\ \text{m}\cdot\text{s}^{-2}$ c) $3.6\ \text{m}\cdot\text{s}^{-1}$ d) $4.0\ \text{m}\cdot\text{s}^{-1}$
e) 7.13 m, $3.47\ \text{m}\cdot\text{s}^{-1}$, $0.53\ \text{m}\cdot\text{s}^{-2}$ f) 2.3 s
4-62 a) Move up b) Constant c) Constant d) Stop

Chapter 5

5-2 a) 1.36 m b) $3\ \text{m}\cdot\text{s}^{-1}$, $-4.43\ \text{m}\cdot\text{s}^{-1}$
5-4 0.189
5-6 1280 ft
5-8 a) At 2 s, $x = 50$ m, $y = 20.4$ m, $v_x = 25.0\ \text{m}\cdot\text{s}^{-1}$, $v_y = 0.40\ \text{m}\cdot\text{s}^{-1}$.
At 3 s, $x = 75$ m, $y = 15.9$ m, $v_x = 25.0\ \text{m}\cdot\text{s}^{-1}$, $v_y = -9.4\ \text{m}\cdot\text{s}^{-1}$.
At 4 s, $x = 100$ m, $y = 1.6$ m, $v_x = 25.0\ \text{m}\cdot\text{s}^{-1}$, $v_y = -19.2\ \text{m}\cdot\text{s}^{-1}$
b) 2.04 s c) 20.4 m d) 4.08 s e) 102 m
5-10 a) 2.5 m b) 18.4°, 71.6°
5-12 30 m
5-14 Yes; ball clears fence by 10 ft.
5-16 a) $1084\ \text{m}\cdot\text{s}^{-1}$ b) $1534\ \text{m}\cdot\text{s}^{-1}$ c) 110.7 s d) 15.4 km
5-18 18.0 m
5-20 a) $226\ \text{m}\cdot\text{s}^{-1}$ b) 902 m c) $180\ \text{m}\cdot\text{s}^{-1}$, $-184\ \text{m}\cdot\text{s}^{-1}$
5-22 a) $32\ \text{ft}\cdot\text{s}^{-1}$ b) 1 s c) 54 ft
5-24 a) 11.7 m b) $8.25\ \text{m}\cdot\text{s}^{-1}$, 76.0° below $+x$-axis c) $4\ \text{m}\cdot\text{s}^{-2}$, $-y$-direction
d) $t = 0$ e) $t = -3$ s, 0, $+3$ s f) (-6 m, 1 m), (0, 19 m), (6 m, 1 m)
5-26 b) $14.0\ \text{m}\cdot\text{s}^{-1}$ c) $2.80\ \text{m}\cdot\text{s}^{-2}$ d) $2.83\ \text{m}\cdot\text{s}^{-2}$ e) 2.77 m
5-28 a) $314\ \text{m}\cdot\text{s}^{-1}$ b) $5035g$ c) 4935 N, 5035 times

5-30 0.210
5-32 0.720 mi
5-34 a) 1.014 $\text{rev}\cdot\text{s}^{-1}$ b) 2.77 N c) 69.0°
5-36 a) 36.0 $\text{rev}\cdot\text{min}^{-1}$ b) 11.0 N
5-38 0.327
5-40 a) 1.98 $\text{m}\cdot\text{s}^{-1}$ b) 2.94 N
5-42 3.13 $\text{m}\cdot\text{s}^{-1}$
5-44 $T_B/T_A = \cos^2 \theta$
5-46 a) $7.68 \times 10^{-3}\ \text{m}\cdot\text{s}^{-2}$ b) 6.20 $\text{m}\cdot\text{s}^{-1}$; yes
5-48 35,870 km above earth's surface
5-50 a) 97.6 min b) 26.5 $\text{ft}\cdot\text{s}^{-2}$
5-52 10.0 oz
5-54 19.5° E of N, 170 $\text{mi}\cdot\text{hr}^{-1}$
5-56 a) 0, 10 $\text{m}\cdot\text{s}^{-1}$ west b) 17.3 $\text{m}\cdot\text{s}^{-1}$, 20 $\text{m}\cdot\text{s}^{-1}$
5-58 a) 41.8° S of E b) 2.24 $\text{m}\cdot\text{s}^{-1}$ c) 447 s

Chapter 6

6-2 573 J, −573 J
6-4 a) 4 J b) −0.8 J
6-6 a) $nRT \ln (V_2/V_1)$ b) $K(V_2^{1-\gamma} - V_1^{1-\gamma})/(1-\gamma)$
6-8 250 J
6-10 10 $\text{m}\cdot\text{s}^{-1}$
6-12 12 N
6-14 2.98×10^6 J
6-16 0.735 J
6-18 a) 60 J, 15 J b) 14.4 J
6-20 a) 200 J; converted to kinetic energy b) 5.00 $\text{m}\cdot\text{s}^{-2}$, 7.07 $\text{m}\cdot\text{s}^{-1}$, 200 J
6-22 a) 49.0 N b) 588 J; potential energy
6-24 a) 261 N b) 784 J
6-26 5.42 $\text{m}\cdot\text{s}^{-1}$
6-28 0.204
6-30 a) 2296 m, 4591 m c) 1148 m
6-32 a) 2.21 $\text{m}\cdot\text{s}^{-1}$ b) 8.49 $\text{m}\cdot\text{s}^{-2}$
6-34 a) $4g$ b) g c) $4.12g$
6-36 $wa \sin \theta + \tfrac{1}{2} ka^2 \theta^2$
6-38 a) 7.81 $\text{m}\cdot\text{s}^{-1}$ b) 0.0424
6-40 $5R/2$
6-42 48.2°
6-44 2374 $\text{m}\cdot\text{s}^{-1}$
6-48 -1.29×10^6 J
6-50 4.38 hp
6-52 a) 3.73¢ b) 5.31×10^5 ft·lb
6-54 $2.98
6-56 2984 N
6-58 a) 7.84×10^4 J b) 160,000 J c) 5.33 hp
6-60 20.4 $\text{m}\cdot\text{s}^{-1}$
6-62 a) 3.17×10^{11} W b) 1.59 kW
6-66 a) 5.74×10^{14} J b) 17,429 kg

Chapter 7

7-2 a) 16 $\text{kg}\cdot\text{m}\cdot\text{s}^{-1}$ b) 8000 N
7-4 b) 0.003 s c) 0.6 N·s d) 2 g

7-6 2500 N; no
7-8 a) 8.85 N·s b) 4427 N
7-10 a) and (b) Comparable c) Same kinetic energy
7-12 a) 587 m·s^{-1} b) 0.002 c) All
7-14 0.300 m
7-16 a) 0.130 m b) 3200 J c) 6.39 J
7-18 a) 0.5 J b) 1.0 m·s^{-1} c) 100 m·s^{-1}
7-20 a) Zero b) 4 m·s^{-1} to left, 1.5 m·s^{-1} to right c) 33 J
7-24 a) 100 g b) 16 cm·s^{-1}
7-28 a) 12.5 m·s^{-1}, 36.9° from initial direction b) No
7-30 v_A = 26.0 m·s^{-1}, v_B = 15 m·s^{-1} at 60° to initial direction of A
7-32 a) 1.6 kg·m·s^{-1} b) 2 collisions·s^{-1} c) 3.2 kg·m·s^{-2} d) 3.2 N
7-34 a) 4 m·s^{-1} b) 4.44 m·s^{-1} c) 5.11 m·s^{-1}
7-36 0.75 J
7-38 a) 0.0894 b) 0.326
7-40 a) 0.075 m·s^{-1} b) 8 N
7-42 a) 0.801 m·s^{-1} b) 8 N c) Smaller, factor of about 1000
7-44 4.62×10^6 m from center of earth
7-46 (−1/3 m, 4/3 m)
7-48 a) 250 N b) Yes
7-50 b) 0.05 s^{-1} e) 15.3g f) 591 m·s^{-2}
7-52 4.23×10^7 m·s^{-1}; greater
7-54 c) Measure mc^2 along hypotenuse; excess length is K.
7-56 7.131 m·s^{-1}; no

Chapter 8

8-2 800 N, 0.75 m from 600–N end
8-4 1.2 m
8-8 a) 667 N b) 533 N, 100 N
8-10 a) 2000 N, 1732 N b) 1732 N, 2000 N c) 897 N, 732 N
d) 2732 N, 3346 N
8-12 1366 N
8-14 0.133 m from 3-kg end
8-16 2.0 m
8-18 4.72, 4.72, 4.17 cm (from common corner)
8-20 60 N, 80 N
8-22 a) 60 N b) 53.1° with horizontal
8-24 a) 3608 N, 3608 N, 7500 N b) No
8-26 a) 480 N b) 330 N c) 5.50 m
8-28 a) 500 N b) 7492 N c) 0.714 of height
8-30 a) 214 N b) 186 N c) 293 N
8-32 a) 10 N b) 5 cm to right of center of gravity c) 0.31 m
8-34 a) On bisector of α, distance ½L cos (α/2) from vertex b) L/3 from bottom
c) $L/2\sqrt{2}$ from corner d) At center

Chapter 9

9-2 503 rad·s^{-1}
9-4 471,942, 1414 cm·s^{-1}; 600, 1800, 5400 rev·min^{-1}
9-6 −12.57 rad·s^{-2}, 58.3 rev, 3.33 s
9-8 7.5 s

9-10 a) 20 rev$\cdot$s^{-1} b) 414.7 rad or 66 rev c) 62.8 m$\cdot$s^{-1} d) 7896 m$\cdot$s^{-2}
9-12 a) 15, 0, 15 cm$\cdot$s^{-2} b) 15, 62.8, 64.6 cm$\cdot$s^{-2} c) 15, 126, 127 cm$\cdot$s^{-2}
9-14 a) 50 m$\cdot$s^{-2} b) 5 m$\cdot$s^{-1}, 50 m$\cdot$s^{-2}
9-16 a) 52.5, 314 rad$\cdot$s^{-1} b) 52.4 rad$\cdot$s^{-2} c) 145 rev d) 78.5 m$\cdot$s^{-1}
e) 13.1 m$\cdot$s^{-2} f) 24,674 m$\cdot$s^{-2}
9-18 a) 1.5 kg$\cdot$m^2 b) 0.75 kg$\cdot$m^2
9-20 0.105 kg$\cdot$m^2
9-22 a) A b) D
9-24 15.8 cm
9-26 a) 1066 J b) 36.3 m
9-28 0.80 kg$\cdot$m^2
9-30 a) 2.0×10^7 J b) 17.9 min
9-32 a) 2.96 rad$\cdot$s^{-2} b) 12.2 rad$\cdot$s^{-1} c) 50,300 J
9-34 0.589
9-36 a) 19.1 kg$\cdot$m^2 b) 2 N$\cdot$m c) 91.7 rev
9-38 a) 63.2 m b) 37.9 N c) 185 N
9-40 a) 0.145 kg$\cdot$m^2 b) 10 N, 39 N
9-42 a) 2.5 rad$\cdot$s^{-2} b) 10 rad$\cdot$s^{-1} c) 500 J d) 10 kg$\cdot$m^2
9-44 $69mr^2$
9-46 $g/(1 + a^2/2b^2)$, $2mg/(1 + 2b^2/a^2)$
9-48 $7ML^2/48$
9-50 $Ma^2/3$
9-52 a) 5937 N$\cdot$m b) 2.37×10^4 N c) 62.8 m$\cdot$s^{-1}
9-54 0.149 rad$\cdot$s^{-1}, less than 1%
9-56 a) 1.125 rad$\cdot$s^{-1} b) 1080 J, 405 J, inelastic collision
9-58 a) 43.0 kg$\cdot$m^2 b) 7.96 rad$\cdot$s^{-1}
c) 108 J, 171 J; man does work pulling dumbells in.
9-60 0.299 m
9-62 a) 3.00 rev$\cdot$min^{-1} b) 3.00 rev$\cdot$min^{-1}
9-64 3000 J
9-66 0.0625 rad$\cdot$s^{-1}
9-68 a) 5954 s, or 1 hr 39 min b) 1.64×10^5 N$\cdot$m
9-70 2.94 rad$\cdot$s^{-1}
9-72 a) 24.5 N up b) 49.2 N up, 0.174 N down c) 148 N up, 98.9 N down
d) 0.040 rev$\cdot$s^{-1}

Chapter 10

10-2 8 ft$\cdot$s^{-2}
10-4 2.0×10^4 Pa, 4.0×10^5 Pa
10-6 a) 1800 N b) 0.010 m c) 3600 N
10-8 a) 1.84×10^{-3}, 1.23×10^{-3} b) 9.19×10^{-4} m, 6.13×10^{-4} m
10-10 a) 7.27×10^{-4} m, 2.00×10^{-4} m b) 0.232 J
10-12 a) 0.700 m from A b) 0.600 m from A
10-14 0.767 in.
10-16 a) 7.96×10^{-5}, 1.45×10^{-4} b) 3.98×10^{-5} m, 7.24×10^{-5} m
c) 3.02×10^{-7} m, 9.26×10^{-7} m
10-18 $(A^2x + FV_0k_0)Fv_0$
10-20 1.033×10^3 kg$\cdot$m^{-3}
10-22 a) 5.55×10^6 Pa b) 2.77×10^{-5} c) 8.32×10^{-5} m
10-24 a) $(F\cos^2\theta)/A$ b) $(F\sin\theta\cos\theta)/A$ c) 0° d) 45°
10-28 0.84×10^6 N

Chapter 11

11-2 b) 0.253 m c) 0.200 J d) 0.179 m e) 2.53 m·s^{-1} f) 0.628 s
g) 1.59 Hz h) 10.0 s^{-1} i) 60°
11-4 a) 17.0 cm b) -4.19×10^{-3} N c) 1.33 s d) 32.6 cm·s^{-1}
11-6 a) 98.0 N·m^{-1} b) 0.898 s c) 1.27 s
11-8 a) 39.2, 0, 0, 39.2 J b) 9.8, 9.8, 19.6, 39.2 J c) 0, 0, 39.2, 39.2 J
11-10 a) 2.09 s b) 9.17 cm c) 0.0918
11-12 c) Yes d) τ^2 vs. m is a straight line e) No f) 97.6 N·m^{-1} g) 30 g
11-14 6.21 cm
11-16 a) ¾, ¼
11-18 a) 0.889 s b) 2.5 m·s^{-2}, down c) 29.2 N d) 0.0740 s e) Remains
f) 19.6 cm above equilibrium
11-20 a) 0.350 m, 0.250 m b) 0.993 s
11-22 a) 0.313 m·s^{-1} b) 0.490 m·s^{-2}
11-24 a) $-\pi\sqrt{L/g^3}\,\Delta g$ b) $-\Delta g/2g$ c) 9.7977 m·s^{-2}
11-26 a) 39.5 rad·s^{-1} b) 34.2 rad·s^{-1} c) 124 rad·s^{-2}
11-28 a) 0.35% b) 9.8696 m·s^{-2}
11-32 a) ∞, 1.04, 0.852, 0.828, 0.852 s
11-34 a) 0.935 b) 1.155 c) Yes; $2(l/3)$

Chapter 12

12-2 0.980×10^5 Pa, 0.967 atm
12-4 6.27×10^6 Pa, 61.9 atm
12-6 25.9 cm^3 b) 3.68 cm^3 c) No
12-8 b) Yes
12-10 1.00 m^3
12-12 5.74 lb
12-14 a) 680 g b) 784 Pa
12-16 77.7 cm^3
12-18 a) 0.426 b) 0.46 of block's height
12-20 a) 1.48 g·cm^{-3} b) 0.400 g·cm^{-3}
12-22 194 kg·m^{-3}
12-24 a) 0.124 m b) 2.73 s
12-26 0.781 g·cm^{-3}
12-28 3.53×10^5 N, 5.88×10^6 N
12-30 19,600 N·m
12-32 a) la/g b) $\omega^2 l^2/2g$ c) Yes; yes
12-34 No
12-36 a) 3193 Pa b) 2.18 cm from end
12-38 0.0143 mm
12-40 a) $h = (2\gamma \cos\theta)/\rho g x$ b) 2.97 cm
12-42 40 dyn·cm^{-2} or 4.0 Pa
12-44 3.73 mm
12-46 1.36×10^5 Pa gauge

Chapter 13

13-2 a) $2\sqrt{h(H-h)}$ b) h
13-4 4.0×10^3 Pa
13-6 1.96×10^5 Pa

13-8 a) $88.9\ \mathrm{m\cdot s^{-1}}$ b) 8144 N
13-10 0.779×10^5 Pa
13-12 a) 25.7 m b) 25.2 N c) 162 N
13-14 a) $4.38\ \mathrm{m\cdot s^{-1}}$ b) $4.38\ \mathrm{m\cdot s^{-1}}$, -0.39×10^5 Pa (gauge)
13-16 $h_2 = 3h_1$
13-18 $0.000535\ \mathrm{m^2}$
13-20 a) 0.75, $3.0\ \mathrm{m\cdot s^{-1}}$ b) 4219 Pa c) 3.16 cm
13-22 $143\ \mathrm{m\cdot s^{-1}}$
13-24 0.5902×10^5 Pa
13-26 a) $368\ \mathrm{m\cdot s^{-1}}$ b) 7.3×10^6; no
13-28 a) $0.326\ \mathrm{cm\cdot s^{-1}}$ b) $51.8\ \mathrm{cm\cdot s^{-1}}$ at 20° C
13-30 665 N down
13-32 a) 1493 b) Laminar
13-34 a) $56.0\ \mathrm{cm^3\cdot s^{-1}}$ b) 56, 112, $280\ \mathrm{cm^3\cdot s^{-1}}$ c) 38.4, 38.4, 33.6, 33.6, 0.0 cm
d) 18.0 cm e) 71.8 cm f) 112, 224, $560\ \mathrm{cm\cdot s^{-1}}$
13-36 a) 1.47×10^6 Pa b) 7.35×10^4 W or 98.6 hp

Chapter 14

14-2 a) Yes b) 37.0° C c) 90.18 K, 162.3° R d) −40°
14-4 −286° C
14-6 a) 108 ohms b) 250° C
14-8 86.59 ft
14-10 a) 75.6° C b) −63.3° C
14-12 1.0036 in.
14-14 a) -1.2×10^{-4} b) Gains 5.19 s per day
14-16 7.17 cm
14-20 $4.34\ \mathrm{cm^3}$
14-22 Rise 2.35 m
14-24 a) 1.60 ft b) 1.60×10^8 Pa or $2.35 \times 10^4\ \mathrm{lb\cdot in^{-2}}$
14-26 a) $1.00 \times 10^{-5}\ (\mathrm{C^\circ})^{-1}$ 1.00×10^9 Pa
14-28 4.80×10^8 Pa
14-32 7.14×10^7 Pa or 705 atm
14-34 70.1° C

Chapter 15

15-2 a) No b) Yes
15-4 87.6 W
15-6 a) 1.87×10^8 Btu b) 42.0 ft or 12.8 m
15-8 55.4° C
15-10 25.0° C
15-12 327° C; bullet partially melts.
15-14 $448\ \mathrm{J\cdot kg^{-1}\cdot(C^\circ)^{-1}}$
15-16 89,037 cal
15-18 0.199
15-20 139 g
15-22 171 m
15-24 $1.01 \times 10^4\ \mathrm{Btu\cdot ft^{-3}}$
15-26 3031 J
15-30 0° C with 200 g of ice melted
15-32 $445\ \mathrm{m\cdot s^{-1}}$

15–34 3.46 g
15–36 100 g
15–38 0.0399 lb
15–40 66.4 g
15–42 2.20

Chapter 16

16–2 a) $-10\ \mathrm{C^{\circ}\cdot cm^{-1}}$ b) $38.5\ \mathrm{J\cdot s^{-1}}$ c) 80.0° C
16–4 a) $320\ \mathrm{cal\cdot s^{-1}}$ b) $194\ \mathrm{C^{\circ}\cdot cm^{-1}}$
16–6 20.0° C
16–8 2.73 cents
16–10 $4.78 \times 10^{-7}\ \mathrm{m\cdot s^{-1}}$, or $4.13\ \mathrm{cm\cdot d^{-1}}$
16–12 a) $48.0\ \mathrm{J\cdot s^{-1}}$ b) 25.8
16–16 a) $4.73\ \mathrm{J\cdot s^{-1}}$ b) Steel 4.3%, copper 95.7%
16–18 a) 2.57 cm b) 2460 Pa
16–20 4.53×10^{5} cal
16–22 2.02 kW
16–24 $1.31\ \mathrm{g\cdot h^{-1}}$
16–26 $0.408\ \mathrm{cm^{2}}$
16–28 a) $6.43 \times 10^{7}\ \mathrm{W\cdot m^{-2}}$ 5803 K

Chapter 17

17–2 0.00143
17–4 a) 0.603 kg b) 0.0881 kg
17–6 123° C
17–8 a) 675 b) 5861 N (598 kg) c) 5419 N (553 kg)
17–10 759 K (486° C)
17–12 a) 927° C b) 0.325 g
17–14 a) 7.10 ft b) $107\ \mathrm{lb\cdot in^{-2}}$
17–16 24.0 cm
17–18 a) $15.5\ \mathrm{m\cdot s^{-1}}$ b) $4.43\ \mathrm{m\cdot s^{-1}}$
17–22 a) Falls b) Rises c) Nearly stationary
17–24 Dry ice is 3.3 times as dense
17–26 a) 0.00143 b) 1.28
17–28 16.2%
17–30 a) 12° C b) $10.3\ \mathrm{g\cdot m^{-3}}$
17–32 0.929 kg

Chapter 18

18–2 a) No b) Yes c) Positive
18–4 2193 J
18–6 $357\ \mathrm{m\cdot s^{-1}}$
18–8 No
18–10 Total internal energy is constant.
18–12 a) 60 J b) Liberate 70 J c) 50 J, 10 J
18–14 3.40×10^{4} J, 3.40×10^{4} J, zero
18–16 a) 3458 J b) 2769 J c) 4989 J e) Isobaric; adiabatic
f) Isobaric; isothermal
18–18 b) 600 K c) 8.0 l·atm or 810 J d) 4.0 atm
18–20 a) 3.43 times as much. b) Hydrogen

18-24 736 K (463° C), 25.1 atm
18-26 25.2, 33.5 $\mathrm{J\cdot mol^{-1}\cdot K^{-1}}$
18-28 3.89×10^5 ft·lb
18-30 b) 1.25×10^4 J c) Zero d) 1.25×10^4 J e) 113 liters

Chapter 19

19-2 a) 2 atm, 3 l; 2 atm, 5 l; 1 atm, 5 l; 1 atm, 3 l b) 203 J c) 203 J d) 9.19%
19-4 a) 93.3 K b) 46.7 K
19-6 a) 1.83×10^7 J b) 1.65×10^6 J
19-8 a) 183 W b) 1848 W
19-10 $(T_\mathrm{H} - T_\mathrm{C})/T_\mathrm{H}$, same
19-12 a) 17.8° C b) 37.3 $\mathrm{J\cdot K^{-1}}$
19-14 a) −446 $\mathrm{J\cdot K^{-1}}$ b) 610 $\mathrm{J\cdot K^{-1}}$ c) Zero d) 164 $\mathrm{J\cdot K^{-1}}$
19-18 a) 2500 MW b) 1500 MW c) 7.17×10^4 $\mathrm{kg\cdot s^{-1}}$ d) 0.143 $\mathrm{m\cdot s^{-1}}$

Chapter 20

20-2 a) 3.10×10^{-10} m b) About the same
20-4 2.44×10^6 molecules
20-6 11.1 mol, 6.69×10^{24} molecules
20-8 4.66×10^{-29} $\mathrm{m^3}$, 3.6×10^{-10} m
20-10 4368 K
20-12 a) All equal b) 1:3,16:7.08
20-14 a) 6.21×10^{-21} J b) 2.34×10^5 $\mathrm{m^2\cdot s^{-2}}$ c) 484 $\mathrm{m\cdot s^{-1}}$
d) 2.57×10^{-23} $\mathrm{kg\cdot m\cdot s^{-1}}$ e) 1.24×10^{-19} N f) 1.24×10^{-17} Pa
g) 8.16×10^{21} molecules h) 2.45×10^{22} molecules (3 times as many)
i) Not all molecules move perpendicular to walls.
20-16 a) 3741 J b) 3754 J c) 12.5 J (same)
20-18 a) 1.60×10^5 K, 1.00×10^4 K
20-20 a) 1.24×10^{-20} kg b) 4.16×10^5 molecules c) 1.4×10^{-6} cm; no, no
20-22 a) 5.31×10^{-46} $\mathrm{kg\cdot m^2}$ b) 2.79×10^{12} $\mathrm{s^{-1}}$
20-24 24.9 $\mathrm{J\cdot mol^{-1}\cdot K^{-1}}$; vibration is significant

Chapter 21

21-2 a) 300 m b) 3.00 m
21-4 a) 1.31 m, 4.79 $\mathrm{m^{-1}}$ b) 1646 $\mathrm{s^{-1}}$ c) 5.53 m
21-8 a) 2 cm, 4 cm, 100 Hz, 10^{-2} s, 400 $\mathrm{cm\cdot s^{-1}}$ c) 8 N
21-10 0.423 $\mathrm{g\cdot m^{-1}}$
21-12 a) 49.5 $\mathrm{m\cdot s^{-1}}$ b) 0.206 m
1-14 0.452 s
1-16 3.60×10^{-6} $(\mathrm{C^\circ})^{-1}$
1-18 a) 17.3 m, 0.0173 m b) 72.5 m, 0.0725 m
1-20 34.9 $\mathrm{m\cdot s^{-1}}$ greater at 57° C
1-22 0.270 s
1-24 0.683
1-26 a) 5345 $\mathrm{m\cdot s^{-1}}$ b) 15.5
1-28 a) $S = Mv^2/L$ b) Stationary or speed $2v$ (with respect to table) c) Mv^2
d) $\frac{1}{2} Mv^2$
e) Sudden accelerations of successive elements of rope are analogous to a series of inelastic collisions; energy is not conserved.

Chapter 22

22-2 a) 400 $\text{m}\cdot\text{s}^{-1}$ b) 1.28×10^9 Pa c) 0.0507 cm

22-4 170 N

22-6 271 Hz

22-8 0.799 He, 0.201 Ne (mole fractions); 44.1% He, 55.9% Ne (by mass)

22-10 3517 $\text{m}\cdot\text{s}^{-1}$

22-12 a) 375 $\text{m}\cdot\text{s}^{-1}$ b) 1.39

22-14 a) 8.76×10^{10} Pa b) 0.239 cm

22-16 a) 35.3 Hz b) 17.6 Hz

22-18 1288 Hz

Chapter 23

23-2 a) 59.5 b) 2.82×10^{-4} c) 35.5 db

23-6 6.99 db; 20 more babies

23-8 a) 8.92 m b) 892 m

23-10 a) −5 db to 125 db b) 18,000 Hz, 70 Hz

23-12 5.95 cm

23-14 2.01%

23-16 a) 1.24%

23-18 a) 0.95, 1.05 m b) 286 Hz

23-20 a) $(c+v)t/\lambda_0$ b) $(c-v)t$ c) $\lambda_0(c-v)/(c+v)$ d) $f_0(c+v)/(c-v)$
e) Beat frequency $2f_0 v(c-v)$

23-22 2.3 $\text{beats}\cdot\text{s}^{-1}$

23-24 c) 7200 $\text{m}\cdot\text{s}^{-1}$

Chapter 24

24-2 3.00×10^{-8} C, 1.00×10^{-8} C

24-4 9.63×10^4 C

24-6 921 N

24-8 a) 9.00×10^{-7} N, away from vacant corner
b) 8.61×10^{-7} N, toward opposite corner

24-10 a) Zero b) $2q^2x/4\pi\epsilon_0(a^2+x^2)^{3/2}$

24-12 b) 1.22×10^{-7} C

24-14 a) 9.04×10^{22} $\text{m}\cdot\text{s}^{-2}$ b) 2.19×10^6 $\text{m}\cdot\text{s}^{-1}$ c) 4.13×10^{16} $\text{rad}\cdot\text{s}^{-1}$

24-16 a) 9.22 N b) 1.38×10^{27} $\text{m}\cdot\text{s}^{-2}$

24-18 Any point for which $(x^2+y^2)^3 = 4x^2a^4$ (q_1 at origin)

24-20 5.40×10^{-5} N, -3.45×10^{-5} N; 6.41×10^{-5} N, 32.6° below +x-axis

Chapter 25

25-2 -3.92×10^{-5} C

25-4 1.42×10^4 $\text{N}\cdot\text{C}^{-1}$

25-6 a) 50.0 $\text{N}\cdot\text{C}^{-1}$, +$x$-direction b) 10.8 $\text{N}\cdot\text{C}^{-1}$, +$x$-direction

25-8 a) Zero b) 1.00×10^4 $\text{N}\cdot\text{C}^{-1}$, +$x$-direction c) 4987 $\text{N}\cdot\text{C}^{-1}$, 76.7°
d) 6364 $\text{N}\cdot\text{C}^{-1}$, +$y$-direction

25-10 a) 1.14×10^{21} $\text{N}\cdot\text{C}^{-1}$ b) 5.17×10^{11} $\text{N}\cdot\text{C}^{-1}$

25-12 2.26×10^9

25-14 $(Q/2\pi\epsilon_0 a^2)[1 - x/(x^2+a^2)^{1/2}]$

25-16 $Q/2\pi^2\epsilon_0 a^2$

25-18 a) Zero b) $qr/4\pi\epsilon_0(R^2+r^2)^{3/2}$, along line

25-20 σ/ϵ_0, zero
25-24 a) $\lambda/2\pi\epsilon_0 r$ b) $\lambda/2\pi\epsilon_0 r$ d) $-\lambda$, $+\lambda$
25-26 a) $\rho r/2\epsilon_0$ b) $\lambda/2\pi\epsilon_0 r$ c) Equal ($\lambda = \pi R^2 \rho$)
25-28 4.53×10^5 C

Chapter 26

26-2 a) 5000 $\text{V}\cdot\text{m}^{-1}$ b) 1.00×10^{-6} J c) 1.00×10^{-6} J
26-4 a) 4.50×10^{-5} J b) 3.00×10^5 $\text{V}\cdot\text{m}^{-1}$ c) 1.50×10^4 V
26-6 a) Zero b) -1.00×10^{-3} J c) 2.30×10^{-3} J
26-8 9430 V
26-10 2.43×10^{-3} J
26-12 5.62×10^7 $\text{m}\cdot\text{s}^{-1}$
26-14 c) $y = \pm a(1 + \sqrt{5})/2$ d) $y = \pm a(1 + \sqrt{2})$
26-16 a) $(qq'/\pi\epsilon_0 ma)^{1/2}$ c) $\sqrt{15}\, a$ d) $(qq'/\pi\epsilon_0 ma)^{1/2}$
26-18 a) 2.19×10^{-5} m b) $v_e/v_p = 42.9$ c) Equal
26-20 a) $(e^2/4\pi\epsilon_0 mR)^{1/2}$ b) $e^2/8\pi\epsilon_0 R$ c) $-e^2/8\pi\epsilon_0 R = -2.18 \times 10^{-18}$ J
26-22 b) 2.30×10^6 $\text{m}\cdot\text{s}^{-1}$
26-24 c) Zero d) $(q - Q)/4\pi\epsilon_0 r^2$
26-26 a) $\rho R^3/3\epsilon_0 r$ outside, $(\rho/2\epsilon_0)(R^2 - r^2/3)$ inside
26-28 a) -89.9 V, -314 V b) 8.97×10^{-7} J
26-30 951 V
26-32 Two
26-34 1.44 MeV
26-36 a) $v = (2qV/m)^{1/2}$ b) 5.93×10^5 $\text{m}\cdot\text{s}^{-1} \cdot V^{-1/2}$ c) 2.24×10^7 $\text{m}\cdot\text{s}^{-1}$
26-38 a) 4.80×10^{-15} N b) 5.27×10^{15} $\text{m}\cdot\text{s}^{-2}$
26-40 124.4 MeV

Chapter 27

27-2 a) 500 V b) 1.25×10^{-4} J c) 0.113 m^2 d) 800 V
27-4 4.25×10^{-4} C
27-6 a) 0.0200 C b) 800 V c) 8.00 J d) 2.00 J
27-8 a) Two in series, in parallel with two others in series
b) Entire 600 V appears across other series capacitor, and it fails.
27-10 a) 1.2 mC, 1.2 kV; 2.4 mC, 1.2 kV b) 0.4 mC, 400 V; 0.8 mC, 400 V
27-12 a) 24.0 μC b) 1.44×10^{-4} J c) 3.6 V d) 1.30×10^{-4} J
27-14 a) 66.7 V b) 100 V c) 300 μC
27-16 1.69 m^2
27-18 a) 0.05 mm b) 0.0910 m^2 c) 1.42 cm
27-20 a) 17.7 pF b) 8.85×10^{-10} C c) 2500 $\text{V}\cdot\text{m}^{-1}$ d) 2.21×10^{-8} J
27-24 a) 0.708 $\mu\text{C}\cdot\text{m}^{-2}$ b) 1.67
27-26 a) 55.3 pF b) 1.66×10^{-8} C c) 2.49×10^{-6} J d) 0.498 $\text{J}\cdot\text{m}^{-3}$
27-28 a) $\epsilon_0 A(d - a)$ b) $[d/(d - a)]C_0$
27-30 $(\lambda/2\pi\epsilon_0)\ln(r_b/r_a)$

Chapter 28

28-2 a) 0.880 A b) Direction of positive ions
28-4 0.96 mA
28-6 a) 1.53 Ω b) 0.382 Ω
28-8 b) Yes c) 4.36 Ω
28-10 a) 604 C b) 121 A

28-12 a) $1.32 \times 10^{-4}\ \Omega$ b) 0.234 m
28-16 25.6 C°
28-18 b) $V_{ab}\, r_a r_b / \rho r^2 (r_b - r_a)$
28-20 224 Ω
28-22 $0.00399\ (\mathrm{C}^\circ)^{-1}$
28-24 $R/9$
28-26 1.52 V, 0.100 Ω
28-28 a) −3.75 V b) 3.75 V c) 4.10 V
28-30 a) 0.0500 Ω b) 0.150 Ω c) 0.00600 Ω
28-32 a) 21.8 Ω b) 5.50 A c) 550 W
28-34 84.3%
28-36 a) + b) 1000 A c) 9.9 Ω d) 13.0 V e) 1120 W f) 990 W
g) 120 W h) 6.72 cents

Chapter 29

29-2 a) $R_1^2/(R_1 + R_2)$ b) $R_1(R_1 + R_2)/R_2$
29-4 27 W
29-6 90 W
29-8 a) 36.0 Ω b) 3.33 A c) 2.00 A, 1.33 A
29-10 a) 0.333 A b) 64 W, 16 W c) 25-W bulb
29-14 a) −6 V b) b c) 6 V d) 54 μC
29-16 0.848, 2.14, 0.171 A
29-18 a) 0.222 V b) 0.464 A
29-20 a) 2 A b) 5 Ω c) 42 V d) 3.5 A
29-22 5/6 Ω
29-24 a) 62.1 V b) 196 V c) 200 V
29-26 420 kΩ
29-28 a) 5.00 mΩ b) 299, 950 Ω
29-30 0.0278, 0.250, 2.50 Ω
29-32 1.00 mA
29-34 3950 Ω in series with G_2, with 210.5 Ω in parallel with the series combination
29-36 a) 2900 Ω b) 0.833 mA c) 9000, 3000, 1000 Ω
29-40 b) There is no current in G.
29-42 a) 0.500 s b) 1.000 s
29-44 a) 393, 632, 865, 1000 μC b) 100, 60.7, 36.8, 13.5, 0 μA c) 10.0 s
d) 6.93 s
29-46 a) $\mathcal{E}Q$ b) ½
29-48 a) CV^2 b) ½ CV^2 c) ½ CV^2 d) ½; independent of R
29-50 a) 5.3 μC b) 2×10^{-3} A c) 2 mA
29-52 a) $5 \times 10^{-5}\ \mathrm{A \cdot m^{-2}}$; $3.34 \times 10^{-10}\ \mathrm{A \cdot m^{-2}}$ b) 9.0 MHz
c) Displacement current leads by 90°

Chapter 30

30-2 a) 0.24 Wb b) Zero c) 0.24 Wb
30-4 a) $2.89 \times 10^7\ \mathrm{m \cdot s^{-1}}$ b) 4.33×10^{-8} s c) 8.67×10^6 V
30-6 a) 2.09 T, toward reader b) 1.57×10^{-8} s
30-8 3.97×10^{-3} T
30-10 0.500 T, in $-y$-direction
30-12 3670
30-14 a) $1.70 \times 10^8\ \mathrm{m \cdot s^{-1}}$ b) 0.483 m
30-16 1.25 mm

Chapter 31

31-2 a) 8.45×10^{-4} m·s^{-1} b) 1.27 mV·m^{-1} c) 25.3 μV
31-4 a) 6.00×10^{-3} N·m b) 0.0400 A·m^2 c) 8.07×10^{-3} N·m
31-6 a) 2.5, 0, −1.5 N b) 2.92 N
31-8 48.0 A
31-10 a) 0.0132 T, +y-direction b) 0.0229 T, −x-direction
31-12 30.0°
31-14 a) 0.800 A b) 3.70 A c) 112.6 V d) 417 W
31-16 b) 1.01×10^6 A·m^{-2}

Chapter 32

32-2 500 A
32-4 a) Zero b) 1.41×10^{-6} T, 45° in xz-plane c) 5.00×10^{-6} T, +x-direction
32-6 a) 6.00×10^{-6} T b) 2.00×10^{-6} T
32-8 b) $\mu_0 Ix/\pi(a^2 + x^2)$
32-10 a) 2.00 A, out of plane b) 2.13×10^{-6} T, to right
c) 2.06×10^{-6} T, 39.1° below horizontal
32-12 2.40×10^{-20} N, away from wire
32-14 46.4 A
32-16 a) $\mu_0 I/2\pi x$ b) $\mu_0 Il\Delta x/2\pi x$ c) $(\mu_0 Il/2\pi)\ln(b/a)$
32-18 a) $8\mu_0 NI/\sqrt{125}a$ b) 1.5×10^{-3} T
32-20 a) 5.03×10^{-4} T b) 4.50×10^{-5} T
32-22 $\mu_0 nQ/\pi a$, along axis
32-24 a) Ir_1^2/R^2 b) $\mu_0 Ir_1/\pi R^2$ c) $\mu_0 I/\pi r_2$
32-26 6.28×10^{-3} T
32-28 Zero; $\mu_0 I(r^2 - a^2)/[\pi r(b^2 - a^2)]$; $\mu_0 I/2\pi r$
32-30 a) 0.250 V·m^{-1} b) 2.00×10^{-4} T c) 25.0 V·m^{-1}·s^{-1}
d) 2.21×10^{-10} A·m^{-2} e) 3.54×10^{-21} T; no

Chapter 33

33-2 a) 2.00 T b) a c) a to b; b to a d) 12.0 V·m^{-1}
33-4 a) 0, 0.0707, 0.141 V b) 0, 0.0707, 0.141 V
33-6 8.79 V
33-10 a) 3.14 V b) 3.14 V
33-12 3.77 V
33-14 a) 0.0200 Wb b) 0.200 V c) 0.00200 N·m
33-16 a) 0.471 V b) From a to b
33-18 7.54 μV
33-20 c) 2.00 μA d) Zero
33-22 a) 5.00 mV·m^{-1} b) 1.00 mV c) Zero d) Zero
33-24 a) $(d\Phi/dt)a^2/2(x^2 + a^2)^{3/2}$ c) $d\Phi/dt$ d) $d\Phi/dt$ e) $d\Phi/dt$
33-26 a) Right to left b) Right to left c) Left to right
33-28 2.70×10^{-4} C
33-30 0.0500 T
33-32 20
33-34 a) $0.02513 + 1.508 \times 10^{-3}\ t^2$ (volts) b) 0.352 mA

Chapter 34

34-2 0.500 mH
34-4 a) $\mu_0 n_1^2 A/2\pi r$, $\mu_0 n_2^2 A/2\pi r$ b) $\mu_0 n_1 n_2 A/2\pi r$

34–6 0.100 V, downstream side at higher potential
34–12 $\mu_0 N^2 I^2 h(b - a)/2\pi a$
34–14 a) 39.8 J·m^{-3} b) 0.0125 J
34–16 a) 4.00 A·s^{-1} b) 2.00 A·s^{-1} c) 0.659 A d) 2.00 A
34–18 a) $V_{ab}R[1 + \exp - (R_0 + R)t/L]/(R_0 + R)$
34–20 a) 6 W b) 1.5 W c) 4.5 W d) 6 J
34–24 $di/dt = -Ri/L$
34–26 0.16 pF
34–28 112.6 to 1013 pF

Chapter 35

35–2 a) 0.2262 T b) 300 A·m^{-1} c) 0.2258 T
35–4 0.302 H, 0.160 H
35–6 b) 0.0108 Wb·A^{-1}·m^{-1} c) 0.005 Wb·A^{-1}·m^{-1} d) 3.7 × 10^{-6} Wb·A^{-1}·m^{-1}
35–8 *a*, 1300; *b*, 1300; *c*, 4000; *d*, ∞; *e*, −1400; *f*, 0
35–10 13.5 A·m^{-1}

Chapter 36

36–2 a) 10.6 MΩ b) 2122 Ω c) 5.31 Ω
36–4 a) 3770 Ω, 37.7 kΩ b) 265 Ω, 26.5 Ω c) 15.9 Hz
36–6 a) 0.500 mA b) 50.0 mA c) 5.00 A
36–8 a) 5.00 A b) 50.0 mA c) 0.500 mA
36–10 a) 949 Ω b) 0.0527 A c) 15.8, 47.4 V d) 71.6°, lag
36–12 a) 400 Ω b) 0.125 A c) 113 V, 62.5 V d) 90°, lag
36–14 21.2, 63.6, 35.4, 28.3, 35.4 V
36–16 a) 514 Ω, 38.8° lead b) 506 Ω, 37.8° lag
36–18 a) $1/\sqrt{LC - R^2C^2/2}$ b) $\sqrt{(1/LC) - (R^2/2L^2)}$
36–20 a) 0.564 A b) 0.213 A c) 20.7° d) 0.603 A
36–22 47.2 Ω
36–24 48.0 W
36–26 a) Inductor b) 0.106 H
36–28 a) 1592 Hz, 1.00 × 10^{4} s^{-1} b) 1.00 A c) 1.00 A d) 0.100 A
e) 5.00 × 10^{-4} J, 5.00 × 10^{-4} J
36–30 a) 10 b) 6.00 A c) 72.0 W d) 200 Ω
36–32 $I_0/2$, $I_0/\sqrt{3}$

Chapter 37

37–2 a) 1.00 × 10^{10} Hz b) 6.67 × 10^{-13} T c) 5.31 × 10^{-11} W·m^{-2}
37–4 3.33 × 10^{-12} T; much smaller
37–6 0.0173 V·m^{-1}, 5.77 × 10^{-11} T
37–8 Circulation around system; no net energy or momentum transfer
37–10 a) 3995 A·m^{-1} b) 0.0753 V·m^{-1} c) 301 W·m^{-2}
37–14 0.110 V·m^{-1}, 2.91 × 10^{-4} A·m^{-1}
37–18 a) 4.67 × 10^{-6} Pa, 4.61 × 10^{-11} atm b) 9.33 × 10^{-6} Pa, 9.21 × 10^{-11} atm

Chapter 38

38–2 1.57 × 10^{-5} to 2.76 × 10^{-5} in.
38–4 229 rad·s^{-1}
38–8 a) 54.7° b) 82.8°
38–10 34.8°

38-14 52,500
38-16 362 nm
38-18 13.4°, 27.1°, 41.8°, 59.0°
38-20 45.6 cm
38-22 1.30
38-24 a) 14.5° b) Air
38-26 a) 44.5°, 63° b) 28.8°, 47.5°
38-28 30°
38-30 37.2°
38-34 2.78 mm
38-36 20.7 m
38-38 28.3 W

Chapter 39

39-2 16.7 m
39-4 −100 cm, 5 cm, virtual, erect
39-6 3.61 cm
39-10 a) 10 cm b) 10 cm
39-14 24.0 cm
39-16 1.50
39-18 a) 12.0 cm b) 24.0 cm c) −12.0 cm
39-20 2
39-22 33.3 cm
39-24 At center of bowl; $m = 1.33$

Chapter 40

40-2 a) 43.7 cm from flat surface b) −1.71
40-4 a) −20 cm b) Virtual c) 8 cm d) Real, inverted e) 0.6 mm
40-6 Inside sphere, 1.5 cm from vertex of silvered surface
40-8 0.667 cm above page
40-10 a) 15, 20, 30, −10 cm b) −0.5, −1, −2, 2 c) Real, real, real, virtual
d) Inverted, inverted, inverted, erect
40-12 a) 120 cm, −3 cm b) 120 cm to right of second lens
c) 21.8 cm to right of second lens d) 80 cm to left of second lens
40-14 4.00 cm
40-16 40.0 cm to right of lens; real, inverted
40-18 a) 3 cm to right of L_2 b) 2 cm to right of L_2 c) 12 cm to left of L_2
d) 10 cm to right of L_2 e) 4.00 cm
40-20 −15 cm
40-22 a) 25 cm to the left b) Virtual
40-24 a) 0.333 cm to right of previous image b) 5.59 m
40-26 0.458 mm
40-28 Yes
40-30 6.50 diopters
40-32 a) 28.6 cm (3.5 diopters) b) −30 cm (−3.33 diopters)
40-34 a) 2.5 b) 7.14 cm
40-36 *f*/5
40-38 a) 2.86 cm b) 1/50 s
40-40 a) 368 b) 2.72×10^{-3} mm
40-42 a) 1.74 cm b) −11.25 c) −112.5

40-44	15.7 cm
40-46	a) −5.00 b) 400 m
40-48	a) Diverging, −20 cm b) 120 cm, 80 cm
40-50	51.04 cm from mirror; between lens and mirror, 25.0 cm from lens; virtual.

Chapter 41

41-2	0.750 mm
41-4	14.5°, 30°, 48.6°, 90°; 7.2°, 22.0°, 38.7°, 61.0°
41-6	545 nm
41-8	480 nm
41-10	0.045 mm
41-12	0.0169°
41-14	2.79 mm
41-16	106 nm
41-18	0.500 mm
41-20	1.77 mm
41-22	12.5°
41-24	0.014 cm
41-26	500 nm
41-28	2000 m
41-30	Smaller by factor of 5/6
41-32	No difference

Chapter 42

42-2	a) $I_0/2$, along first axis; $I_0/4$, along second axis; $I_0/8$, along third axis b) No light transmitted
42-6	a) 0.75 b) 0.50 c) 0.25
42-8	54.7°
42-10	a) 32.0° b) 1.60
42-12	a) 63.9° b) 2.88 cm
42-14	356 nm, 396 nm
42-18	2, linearly polarized at 45°; 3, elliptical; 4, linearly polarized at 60°
42-20	Elliptical

Chapter 43

43-2	a) 1.63×10^{-5} s b) 4842 m
43-8	6.71×10^{8} m
43-10	a) $0.995c$ b) 0.5%
43-12	$0.883c$
43-14	a) $4.21 \times 10^{7}\ \mathrm{m \cdot s^{-1}}$ b) Greater
43-16	$7130\ \mathrm{m \cdot s^{-1}}$; no
43-18	$2.60 \times 10^{8}\ \mathrm{m \cdot s^{-1}}$
43-20	$0.00504mc^2$, $4.79mc^2$
43-22	111 kg
43-24	a) 5.70×10^{14} J b) 1.76×10^{4} kg
43-28	a) 0.99996 b) $4.78 \times 10^{10}\ \mathrm{m \cdot s^{-1}}$

Chapter 44

44-2	2.35 eV
44-4	289 nm

44-6 a) 1.45 V b) 1.45 eV c) 7.14×10^{5} m·s^{-1}
44-8 a) 622, 311, 553, 345 nm b) Cu, Zn
44-10 b) 13.6 eV
44-14 a) 12.7 eV b) Six
44-16 621 nm; radiation is emitted in all directions.
44-18 a) 180 keV b) 2.02×10^{8} m·s^{-1} c) 2.51×10^{8} m·s^{-1}
44-20 7,723 K

Chapter 45

45-2 a) 54.2 eV b) −108 eV c) −54.2 eV d) 54.2 eV
45-4 a) -3.45×10^{-4} eV, -2.30×10^{-4} eV b) 0.04 nm
45-6 1.090×10^{7} m^{-1}
45-8 a) 5.29×10^{45} c) 3.02×10^{-39} m
45-10 a) 54.2 eV b) 22.9 nm c) Far ultraviolet
45-12 1.8 to 3 eV; 0.71 to 0.91 nm
45-14 a) 0.242 nm b) 1.33×10^{-13} m
45-16 a) 8.68×10^{-11} m b) Particle-like
45-18 1.3×10^{-23} kg·m·s^{-1}, 2.0×10^{-24} kg·m·s^{-1}
45-20 a) 1.0×10^{-8} m b) No
45-22 1.47×10^{-35} kg; 6.1×10^{-8}
45-24 1.11×10^{-23} J or 6.95×10^{-5} eV

Chapter 46

46-2 7
46-4 1.15×10^{-18} J or 7.19 eV
46-8 2.71×10^{-47} kg·m^{2}
46-10 5.33×10^{-46} kg·m^{2}
46-12 a) 0.535 eV b) 2320 nm c) 4, 5
46-14 2.17 g·cm^{-3}
46-16 1776 nm, infrared

Chapter 47

47-2 4.84×10^{-14} m
47-4 2.3×10^{17} kg·m^{-3}; larger by 10^{14}
47-6 2.23 MeV
47-8 620 MeV
47-10 16,700 yr
47-12 a) 1.54×10^{-10} yr^{-1} or 4.89×10^{-18} s^{-1} b) 2990 kg c) 1.23×10^{4} s^{-1}
47-14 a) 4.15×10^{-9} s^{-1} b) 1.00×10^{20} atoms c) 4.15×10^{11} s^{-1}
d) 11.3 curie, 1130 times as great
47-16 a) 4.60×10^{7} reversals·s^{-1} (frequency 2.30×10^{7} Hz) b) 5.06×10^{7} m·s^{-1}
c) 13.7 MV
47-18 1.93×10^{13} J·mol^{-1}; larger by 10^{8}
47-20 Binding energy for an alpha particle is less than that for a single nucleon.
47-22 67.5 MeV (or 1.08×10^{-11} J), 1.63×10^{22} Hz, 1.84×10^{-14} m.

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